

(RT042079) had a maximum value for total metals that was greater than total metal values at stations found in previous survey periods (2000-2002).

Stations where individual contaminant concentrations in fish tissue exceeded the 90th percentile for tissue contaminants in the 2000-2002 SCECAP data set were also evaluated to identify potentially contaminated habitats. The number of contaminants that exceeded the 90th percentile were counted at each station, and stations were ranked based on the number of exceedences. Due to changes in the method detection limits for PAHs, these contaminants were left out of this analysis. Exceedence values ranged from zero (no contaminants exceeded their respective 90th percentile value) to 14 exceedences at station RT042194 in the upper Ashley River. Of the six random stations that had 7 or more exceedences, four of the stations were in suburban or urbanized rivers: RO036054 in Winyah Bay, RT042194 and RT032046 in the Ashley River, and RO046087 in the Beaufort River. The distribution of contaminated fish tissue in 2003-2004 was similar to previous survey periods where the most highly contaminated fish were caught in suburban and urban rivers such as the Ashley River and the upper part of Winyah Bay.

3.5 Incidence of Litter

Solid waste products, or litter, represent an inevitable consequence of human presence in natural systems. As development and recreational and commercial activities continue to increase in South Carolina's coastal zone, the amount of litter entering our estuaries, flushing into the open ocean, and washing up on beaches is expected to increase.

During 2003 and 2004, litter was visible in 13% of the state's tidal creek habitat and 3% of state's open water habitat. This represented a decrease since the 2001-2002 survey period (during which 20% of tidal creek and 8% of open water habitat had litter), but litter remained elevated well above the 1999-2000 levels (2% of tidal creek and 3% of open water habitat). Generally, the greater percentages of tidal creek sites having litter relative to open water sites likely reflects the closer proximity of tidal creeks to human populations as well as the presence of shoreline, vegetation and oyster reefs that can retain

litter within the viewing distance of the survey crews. The reduction in litter over the previous survey period may reflect the flushing of litter out of our estuaries by increased freshwater inflow or just normal variability among survey periods. Considering the year-to-year variability, additional monitoring will be necessary to determine long term trends in litter.

3.6. Integrated Measures of South Carolina's Estuarine Habitat Quality

SCECAP is unique compared to most state and federal monitoring programs because it combines integrated measures of water quality, sediment quality, and biological condition into an overall measure of habitat quality at each site and for the entire coastal zone within its coverage area. Multi-metric measures provide a more reliable assessment than any single measure or group of measures representing only one component of the habitat. For example, poor or fair water quality based on state standards or historical data may not result in any clear evidence of impaired biotic communities. Many of South Carolina's state water quality standards are intentionally conservative to be protective and some contraventions of these standards are not severe enough to result in biological impairment. Similarly, fair or poor sediment quality may not result in degraded biotic condition because the organisms are either not directly exposed to the sediments (e.g., phytoplankton, fish) or because the contaminants are not readily bioavailable to the organisms. When two or more of the three measures (e.g., water quality, sediment quality, or biotic condition) are only fair or poor, there is increased certainty that the habitat may be limiting. While several studies have used a "triad" approach to measuring bottom sediment quality (e.g., Chapman, 1990; Chapman *et al.*, 1991), very few programs have been established elsewhere that use a more holistic approach that includes water quality variables. The USEPA National Coastal Assessment Program is the most successful federal program to use an approach similar to SCECAP, although the habitat metrics and method of integrating those metrics are very different (USEPA, 2001, 2004).

The overall index of habitat quality currently used by SCECAP is described by Van Dolah *et al.* (2004a, available online). This index weights each

of the three components equally (i.e., water quality, sediment quality, and benthic IBI scores). A site is considered to have poor habitat quality if two or more of the components score as poor, or if one component scores as poor and the other two score only fair. A site is considered to have fair habitat quality if two or more of the habitat quality components score as fair or only one component scores as poor. A site is considered to have good habitat quality if all three components score as good or if only one of the components scores no worse than fair.

Using this approach, approximately 80% of South Carolina's open water habitat and 77% of the state's tidal creek habitat were considered to have good overall habitat quality during the 2003-2004 survey (Figure 3.6.1). Approximately 18% of the state's open water habitat and 20% of the state's tidal creek habitat were considered to have fair overall habitat quality, and only 2% and 3% of the state's open water and tidal creek habitat, respectively, were considered to have poor overall habitat quality. The overall habitat quality scores for each of the stations sampled in 2003 and 2004 are presented in Appendix 2 along with the integrated water quality, integrated sediment quality, and B-IBI scores and their component parameter scores.

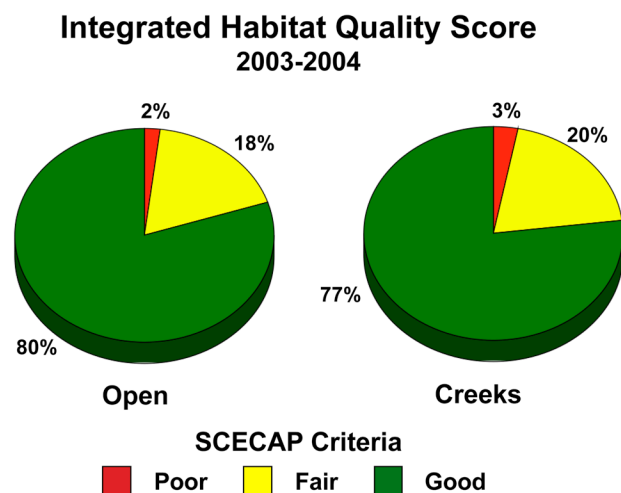


Figure 3.6.1. Estimated percentage of South Carolina's estuarine tidal creek and open water habitat that is in good, fair, or poor condition using an average of water, sediment, and biological quality scores developed for the SCECAP monitoring effort.

The proportion of the state's estuarine habitat that was considered to be either fair or poor was similar (within 1%) to that observed in the 2001-2002 survey. Fifteen of the tidal creek stations possessed fair to poor water quality scores while only seven open water stations possessed fair and none possessed poor water quality scores (Appendix 2). Additionally, there were comparable numbers of sites in each habitat with fair sediment quality (neither habitat had stations with poor sediment quality) and with fair or poor benthic community condition measures. In the 2001-2002 survey, tidal creeks had a higher percentage of sites with degraded sediment quality compared to open water sites (Van Dolah *et al.*, 2004a), but a similar trend was not observed during this survey.

The 2003-2004 array of stations is presented in Figure 3.6.2 – 3.6.4 with each station color-coded based on its overall integrated habitat quality score. No open water stations scored as poor. Only one tidal creek site had an overall poor rating during the 2003-2004 survey, and was located near Middleton Gardens in the Ashley River (RT042194). This site had poor water quality due to very high nutrients (TN and TP) and high fecal coliform bacteria. Sediment quality at this same site scored as only fair, and the Benthic IBI scored as poor. This latter component may be an artifact of the very low salinity of this site because the database used for developing the B-IBI is not as robust at salinities less than 18ppt.

Seven of the 12 sites (58%) sampled in the northern portion of the state during 2003-2004 scored as only fair in overall habitat quality, with the remaining sites (42%) scoring as good in overall habitat quality (Figure 3.6.2). Four of the fair sites were located in the Winyah Bay estuarine system and the other three fair sites were located in the Santee River system. Winyah Bay has generally had a significant proportion of stations that code as fair or poor in previous surveys (Figure 3.6.5), most likely due to the proximity of industrial and urban development. It is less clear why the majority of the Santee River sites only receive a fair rating as there were no consistent problems among the stations. However, this drainage system occasionally receives large water inputs from upland via releases from the dams upstream, and a substantial amount of the estuarine portion of the Santee River has been impounded to attract waterfowl.

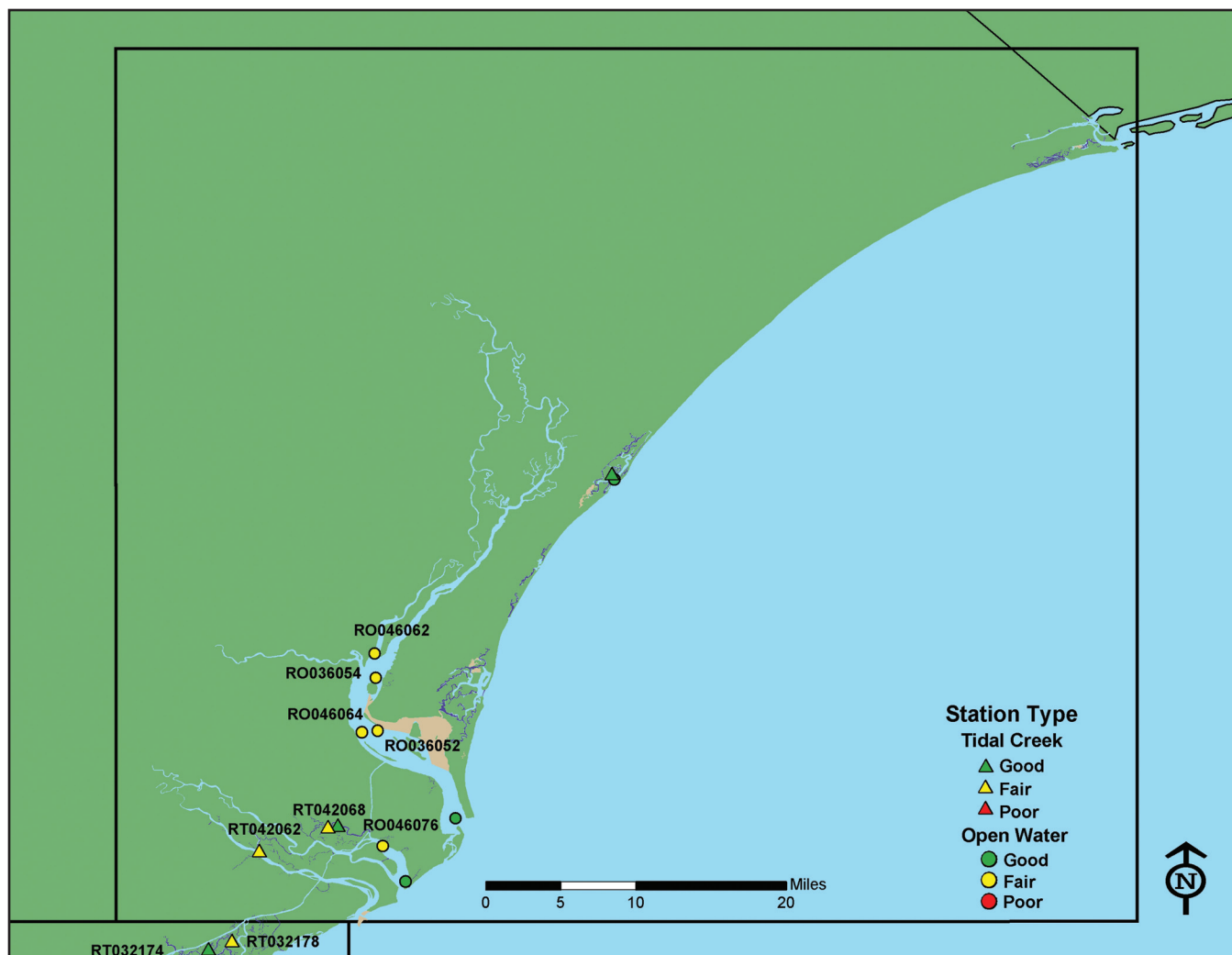


Figure 3.6.2. Distribution of open water and tidal creek stations sampled in the northern portion of the state during 2003-2004 that had an integrated habitat quality score of good, fair, or poor based on an integrated measure of water quality, sediment quality, and biotic condition.

Of the 42 randomly located sites sampled in the central portion of the state's coastal zone, eight (19%) scored as fair, one site (RT042194) scored as poor and the rest (79%) scored as good in overall habitat quality (Figure 3.6.3). The poor site and six of the fair sites were located in the Charleston Harbor estuary or adjacent Stono River; four of those were in tidal creek habitats. All of the impaired sites in the Charleston Harbor estuary were located in the upper reaches of the Ashley, Cooper and Wando Rivers. In previous surveys, the majority of stations showing some impairment generally were located closer to the harbor basin in the lower reaches of these rivers. The Ashley River continues to show evidence of water quality problems, especially with respect to

nutrients and fecal coliform bacteria. Both of the sites sampled in the upper Ashley River also had poor benthic communities, which may be reflective of the very low salinity conditions at those sites. The sites in the Cooper and Wando Rivers that scored as fair in overall habitat quality all had good water quality, but only fair sediment quality and fair to poor benthic community condition. Greater strain will be placed on these already impaired systems as the Charleston metropolitan area continues to grow along the upper reaches of the Ashley, Cooper and Wando Rivers.

In the southern portion of the state, only 12 of the 68 randomly selected sites (18%) were fair in overall habitat quality, and the remaining sites had

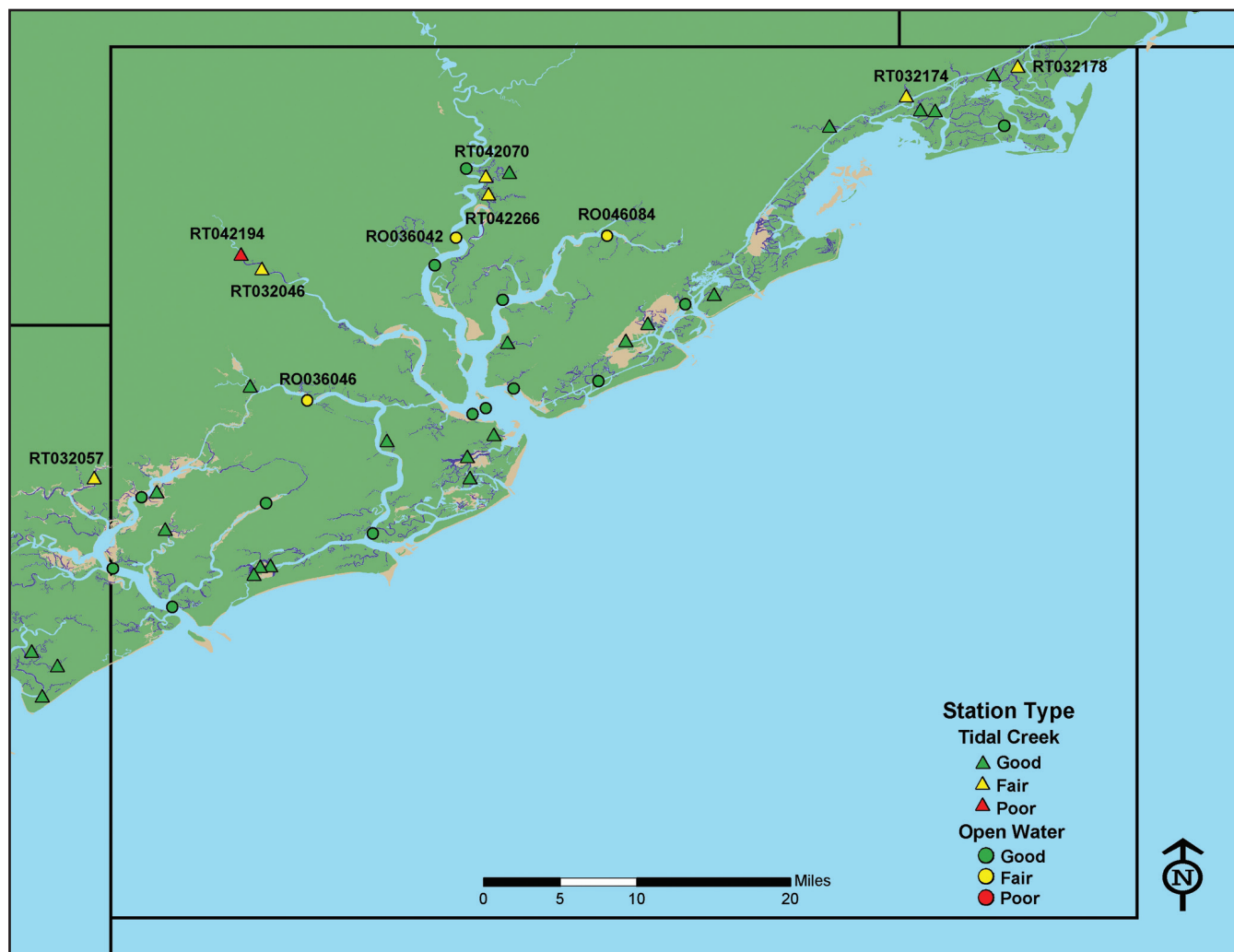


Figure 3.6.3. Distribution of open water and tidal creek stations sampled in the central portion of the state during 2003-2004 that had an integrated habitat quality score of good, fair, or poor based on an integrated measure of water quality, sediment quality, and biotic condition.

good overall habitat quality (Figure 3.6.4). This is very comparable to conditions observed in previous surveys, which indicated generally better overall habitat quality than in the more developed central and northern estuaries. The majority of the sites that showed some impairment were located in tidal creeks. Five of the stations with fair habitat quality were located in the Ashepoo, Combahee, Edisto (ACE) River Basin (RT032031, RT032035, RT032177, RO036043, RO046071), one was located in Dewees Creek located off the North Edisto River (RT032057), two were located in creeks behind Fripp Island (RT032188, RT032056), one behind St. Philips Island (RO046074), one was located in the Savannah River (RO046061), and the remaining two were located in

the New River (RT042063) and Cooper River west of Calibogue Sound (RO036053) in the southern part of the state. There was no consistent reason for the partial impairment of these sites, although many had evidence of high nutrient concentrations and/or high fecal coliform bacterial levels. Many of these sites were in areas that drain agricultural lands.

One of the advantages of the SCECAP sampling protocol is that stations are relocated each year on a random basis. Since the inception of the program, this has resulted in the assessment of a large array of stations (> 350) state-wide that provide some insight as to where the greatest threats in estuarine habitat quality exist. Considering the distribution of only

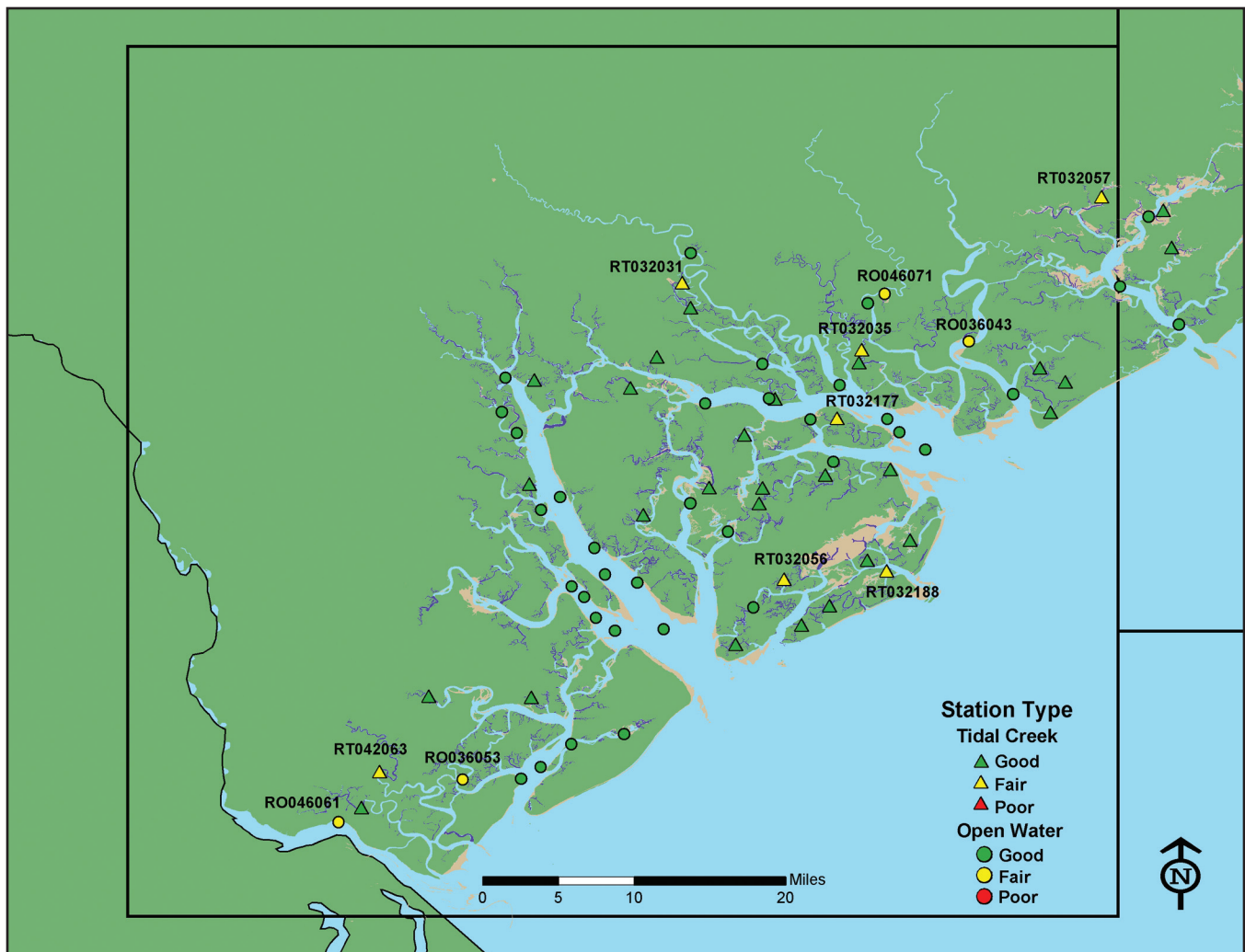


Figure 3.6.4. Distribution of open water and tidal creek stations sampled in the southern portion of the state during 2003-2004 that had an integrated habitat quality score of good, fair, or poor based on an integrated measure of water quality, sediment quality, and biotic condition.

those stations that received either fair or poor scores, sites with a poor habitat quality rating were primarily located in Winyah Bay and the Charleston Harbor estuary, especially in the Ashley River (Figure 3.6.5). While only one site in the southern portion of the state had a poor score, there was a substantial number with only a fair habitat quality score, especially in the upper portions of the ACE Basin. SCECAP staff plan to further evaluate potential causes for impairment in the ACE Basin, but a preliminary assessment of land use patterns suggests that much of the impairment may be due to proximity of agricultural activities.



The Ashepoo-Combahee-Edisto (ACE) Basin, a popular ecotourism destination in South Carolina, is surrounded by agricultural operations.

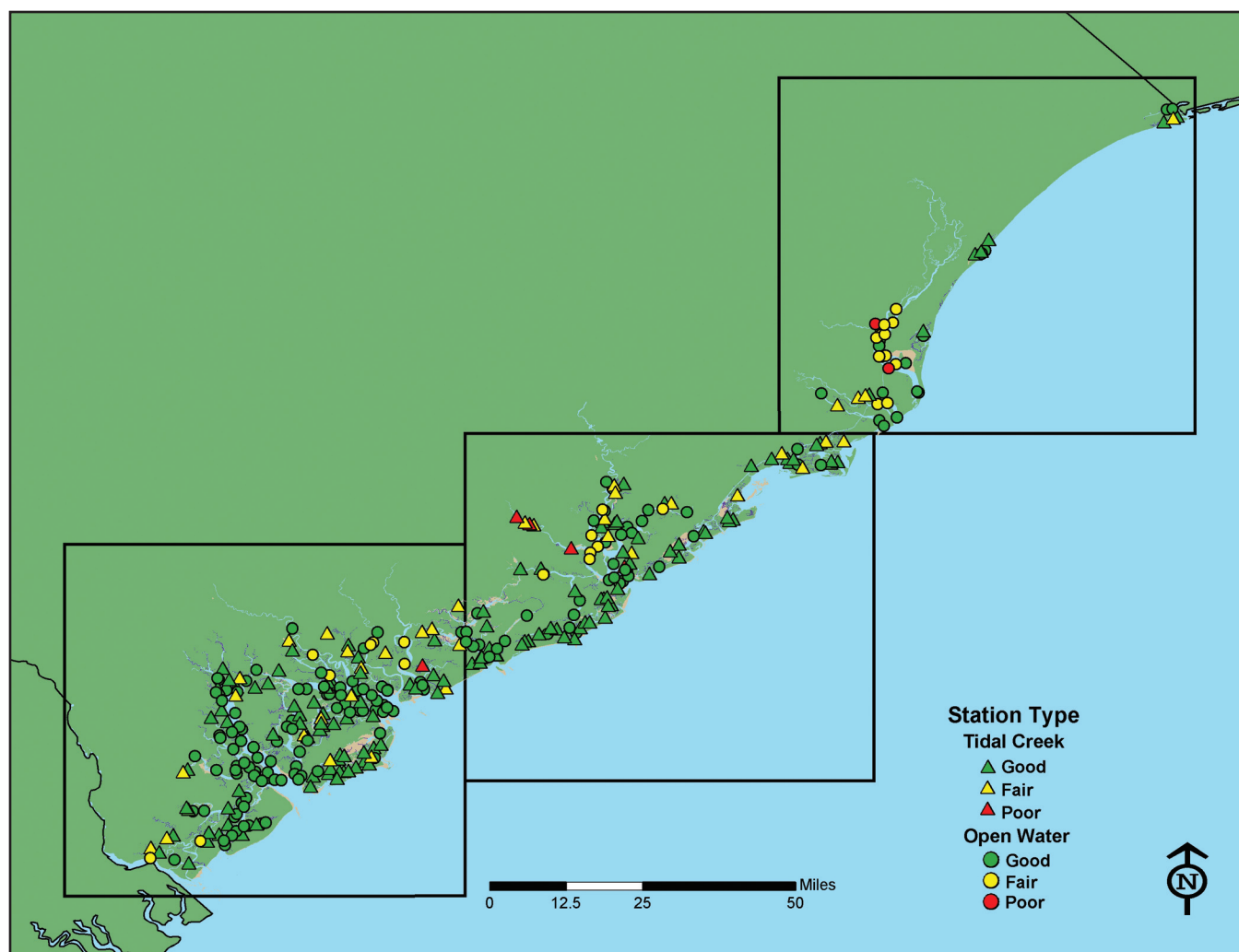


Figure 3.6.5. Distribution of open water and tidal stations sampled in South Carolina between 1999 and 2004 that had an integrated habitat quality score of good, fair, or poor based on an integrated measure of water quality, sediment quality, and biotic condition.

Figure 3.6.6 depicts the overall trend in habitat quality by year for both tidal creek and open water habitats combined, as well as for each habitat separately. As mentioned earlier in the report, tidal creek habitats represent only 17% of the overall estuarine habitat in the state and are therefore weighted less in the combined habitat assessment.

Since 2000, there has been a slight decrease in percentage of the state's estuarine habitat that is considered to be good (approximately 5%), although it should be noted that 1999 was comparable to the percentage in 2004. When evaluating overall habitat quality for open water habitat only, there is a greater decline of approximately 13% in the amount

of good estuarine habitat from 1999 to 2004. This same pattern was not observed in tidal creeks, which showed relatively similar percentages of good tidal creek habitat from 1999-2003, and then an increase in 2004 (Figure 3.6.6). While none of these trends are statistically significant, it will be critical to continue monitoring overall habitat quality to determine whether the increasing impairment noted in open water habitat and all habitats combined poses a long-term threat to the health of our estuaries.

3.7 Future Program Activities

The SCECAP database has already provided a valuable resource that continues to be tapped by

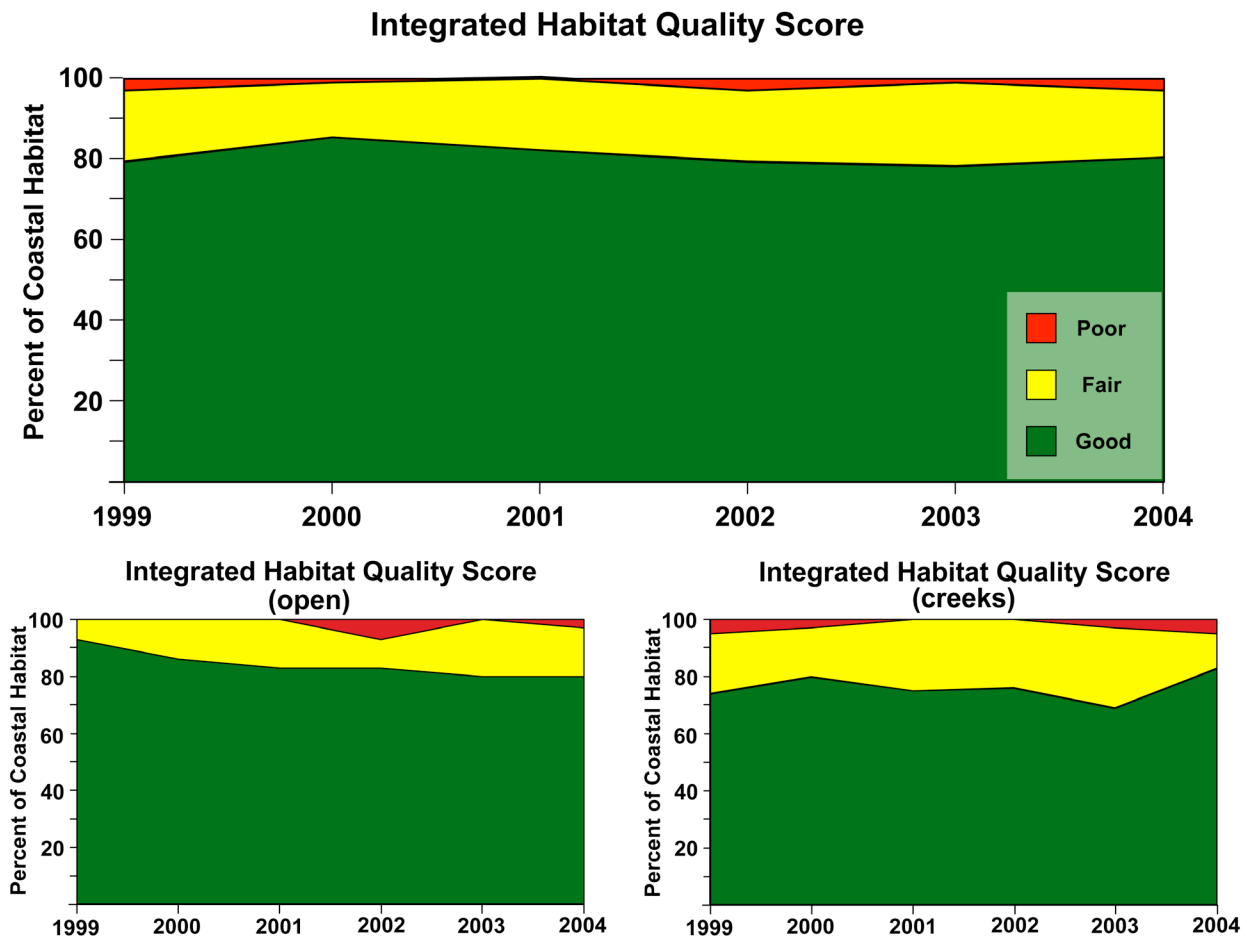


Figure 3.6.6. The proportion of South Carolina's estuarine habitat that ranks as good (green), fair (yellow) or poor (red) using the integrated habitat quality score when tidal creek and open water habitats are combined and compared on an annual basis.

programs within the SCDNR as well as by other governmental agencies and non-profit organizations. For example, the NOAA Dolphin Survey and the NOAA Oceans and Human Health Initiative (OHHI) have mined the SCECAP database in order to relate estuarine environmental measures with dolphin health and land use characteristics, respectively. In 2002-2003, a multi-agency study was conducted for the Town of Bluffton to assess the existing health of the May River (Van Dolah *et al.*, 2004b). That study utilized a comparable sampling approach and relied on existing SCECAP sampling to obtain data from relatively pristine estuarine locations sampled in the southern portion of the state for comparison as reference sites, thereby considerably reducing expenses for the Town of Bluffton. The Nature Conservancy is currently utilizing the SCECAP database to evaluate the condition and integrity

of the Sewee-Santee-Winyah estuarine complex in order to develop a conservation action plan for the area. Additional analyses are also in progress using SCECAP and other databases to evaluate the relationships between land use patterns and estuarine habitat quality (Van Dolah *et al.*, in prep.) with the longer-term goal of developing models describing the interactions between human development and coastal ecosystems.

Funding for SCECAP through the USEPA is expected to be terminated in 2007. This will necessitate a major restructuring of the program with respect to environmental variables assessed and number of sites sampled per year, dependent on alternative funding sources. Given the growth in South Carolina's coastal zone and the likelihood that this will result in further degradation of our estuaries, it is imperative that the